Final Project Report to the NYS IPM Program, Agricultural IPM 2000 – 2001

Title:
Relationship of Sweet Corn Silking Stage to Oviposition by the Corn Earworm

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Abstract:
Corn earworm (CEW) is an annual pest of sweet corn in most of the Northeastern US and requires multiple applications of insecticides to manage below a threshold level. It is commonly believed that CEW do not oviposit (i.e., lay eggs) on sweet corn silks after they have dried. If true, insecticide treatments could logically cease at some predetermined time interval after pollination, because silks commence drying within hours of pollination. Problematic however, is that neither conventional wisdom, nor the historical literature, precisely defines the point at which silks are sufficiently dry to become unattractive for oviposition. We hypothesized that CEW cease to oviposit on silks that are 50% dried. Field experiments, utilizing silk dryness treatments ranging from 0% to 75% and methods to prevent oviposition before the silk dryness targets were attained, were performed during 2001 by which to better define a silk stage treatment threshold for CEW. Under high infestation pressure from CEW, results did not confirm our hypothesis, for 50% and 75% silk dryness treatments yielded 58.4% and 44.3% infestation of ears, respectively. Visual estimations of silk dryness however, correspond well to simultaneous measurements of % loss of silk wt. Possible reasons for the erroneous hypothesis are discussed.

Background and justification:
A concept handed down for decades implies that CEW do not oviposit on sweet corn silks after they have dried. If this is indeed true, insecticide treatments could logically cease at some predetermined time interval after pollination, because silks commence drying within hours of pollination. Adherence to this concept could potentially save growers two to three silk sprays during the periods of peak oviposition.

A search of the early literature pertaining to the egg-laying habits of CEW revealed that the concept probably originated from the classic work of Phillips & Barber (1933). They reported that peak oviposition on field corn occurred 3 da after 1st silk, and that ª90% of total oviposition had occurred by the 16th or 17th day after 1st silk - at which point 50% of the silks had ceased to be moist. From this information it has been generally concluded that CEW do not lay eggs on dried silks, and the concept has survived untested on sweet corn. The original work of these authors however, does not clearly or precisely define what they meant by 'silk drying'; stating only that a proportion of silks ceased to be moist. Because this concept is generally perceived to be valid, and producers often use the underlying principal, field research is needed to verify or identify situations in which treatment for CEW could cease according to a silk stage threshold.

Objectives:

1. To elucidate sweet corn physiological (% silk moisture over time) and morphological (visual estimations of silk dryness) parameters that define the relationships among 'silk drying' and oviposition by CEW.
2. To examine a hypothesis that CEW cease to oviposit on silks that are 50% dried (based on visual estimates).

Procedures:

Two sequentially planted field plots (40 rows x 125 ft) were established at the Hudson Valley Lab vegetable research facility in New Paltz, NY. Only one plot, the one most closely approximating early-Sept silking, was used for experiments. Experiments were arranged in a paired-row configuration, one used as a control, the other used to establish 5 silk dryness treatments: 1) fresh silk moisture; 2) silk 10% dry; 3) silk 25% dry; 4) silk 50% dry; and 5) silk 75% dry. Each treatment consisted of 25 plants selected for uniform stature and silking date, and was replicated four times. No insecticides were used.

Because any method to protect silks from natural oviposition by CEW also prevents the natural pollination necessary for development of kernels, we employed bagging - tassel and shoot bagging is a conventional technique used by corn breeders to control pollen transfer. At the onset of pollen shed, all tassels in treatments 2 through 4 were bagged to collect pollen, and primary ears were shoot (silk) bagged to prevent natural infestation by CEW (treatment #1 was allowed to pollinate and be infested by natural means). After 48 hr, treatments were manually pollinated from pollen collected in tassel bags; shoot bags were replaced to prevent oviposition by CEW.

Daily estimations of silk browning from the companion rows were used to determine degrees of silk dryness; also, 10 silk masses were collected daily and weighed to determine % moisture loss over time (relative to fresh wt. on 'day +2'), as a comparison to our dryness estimates. When targeted silk dryness levels (e.g., 10% moisture, etc.) were attained, shoot bags were removed to facilitate natural oviposition. Ovipositional preference for each silk dryness treatment was assessed by harvest evaluations of infested ears (25 plants/rep). The procedures and time sequences are summarized in Figure 1.

Figure 1.

Date	Tmt. days	Plant Phenology & Procedure
All treatments		
9/2	day -1	Early green-tassel stage; 100 plants/tmt of similar silking stage tagged for subsequent attention.
Treatments 2 - 5		
9/3	day 0	Beginning of pollen shed & 1st silk; tassel bags (to collect pollen) and shoot bags (to prevent oviposition) were emplaced.
9/5	day +2	Treatments hand pollinated; shoot bags replaced.
9/7	day +4	Shoot bags removed from treatment #2 (estimated 10% dry silk).
9/9	day +6	Shoot bags removed from treatment #3 (estimated 25% dry silk).
9/12	day +9	Shoot bags removed from treatment #4 (estimated 50% dry silk).

9/16	day +13	Shoot bags removed from treatment #5 (estimated 75% dry silk).
9/19	day +16	Silks completely dry.
9/24	day +21	Harvest maturity; evaluation of all treatments for infested ears.

Results and discussion:

Results are presented in Table 1. Our hypothesis that CEW cease to oviposit on silks that are 50% dry was based on the work of Phillips & Barber (1933) in which they stated that 90% of oviposition occurred by day 16 or 17 after first silk, a point at which 50% of silks "ceased to be moist" (i.e., 50% dry silk). Our results did not validate the hypothesis. The treatment that was protected from oviposition until the estimated 50% dryness yielded 58.4% infested ears. Moreover, the 75% dry silk treatment yielded 44.3% infestation, only 32% less infestation than silks exposed to oviposition when 10% dry (Tmt. #2). Regression analysis showed a very strong relationship between visual estimations of silk dryness and measurements of percent loss of silk wt. ($y = -1.16 + .188x$; $r^2 = 0.953$; $P<0.0009$), suggesting that visual estimates accurately represented degrees of silk dryness. Moreover, results showing 21 da from 1st silk to harvest maturity (Fig. 1) verifies the common 'rule of thumb' that sweet corn matures 3 wk after 1st silk.

These preliminary results suggest that CEW adults do not discriminate against oviposition on dry silks, at least not to the extent implied by historical data. Earlier research however, was performed in Virginia not the Northeast, and on field corn rather than sweet corn. Apparently the time frame for sweet corn silk maturity differs from that of field corn. Other factors may have confounded or influenced our results. Cultivars have differential silking characteristics (Phillips & Barber 1936), and this initial study included only a single cultivar – other cultivars should be included in future research. Within our procedure, silks protected from oviposition by shoot bags were also shielded from wind and direct sunlight, and thus dried at a slower rate than did silks exposed to the elements. For future studies, we have devised a different apparatus that will protect from oviposition, but will also allow for more natural drying conditions.

It was assumed that all objectives could not be accomplished during a single season. Work toward the establishment of a silk dryness threshold will continue. If determined to be of practical value, it could potentially aid in current IPM efforts on sweet corn and assist producers in deciding when insecticide applications for CEW can cease.

References:

Phillips, W. J. and G. W. Barber. 1933. Egg-laying habits and fate of eggs of the corn earworm moth and factors affecting them. Va. Polytech. Inst., Bull # 47. 14pp.

Phillips, W. J. and G. W. Barber. 1936. Oviposition by <u>Heliothis obsoleta</u> Fab. on the silks of corn. Va. Polytech. Inst., Bull # 58. 14pp.

Table 1. Relationship of sweet corn silk dryness to oviposition and infestation by the corn earworm, Cornell's Hudson Valley Lab., Highland, NY – 2001.

Treatment[1]	No. days after fresh silk	% silk wt. loss[2]	% infested ears[3]
1. Fresh silk; no protection from oviposition	0	0.0	63.9 b
2. Protection from oviposition removed when silks 10% dry	4	30.2	64.8 b
3. Protection from oviposition removed when silks 25% dry	6	44.0	55.8 ab
4. Protection from oviposition removed when silks 50% dry	9	61.4	58.4 b
5. Protection from oviposition removed when silks 75% dry	13	76.0	44.3 a
* Silks 100% dry	16	83.4	NA

Treatment means followed by the same letter are not significantly different (P<0.05; Fisher's Protected LSD test). Data subjected to arcsine transformation prior to analysis.

[1]Estimates of the relative amount of brown silk in an entire silk mass.

[2] Treatment wts. of silk masses relative to base wts. of silk masses sampled at fresh silk.

[3]Species complex: European corn borer, 6.7%; fall armyworm, 0.5%; corn earworm, 92.8%.